APPLICATION FOR UNITED STATES LETTERS PATENT

SOLUTION SPINNING PROCESS FOR THE PRODUCTION OF A TEXTILE FIBER MATERIAL WITH A PERMANENT REPELLENT ACTION

BM-133

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of International application PCT/EP02/00318 filed January 15, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a process for the production of a textile fiber which has a permanent repellent action.

2. Description of the Related Art

Textile materials with repellent properties especially for the repulsion of oil, water, and dirt are known in the state of the art. Thus, EP 0 377 813 describes a canopy top material for motor vehicles, where, to achieve the desired repellent properties, the surface fabric is finished with a repellent

agent, specifically in this case with a polymer based on fluoropolymers. Fluorine waxes for clothing textiles are also known; these can be in the form of impregnating sprays, which are sprayed onto the surface of the fibers. The disadvantage, however, is that these repellents wear off over the course of time, because they are not bound permanently to the surface of the fiber.

Known fluorocarbon systems with improved repellent properties are provided with resin groups (melamine resins, polyisocyanates), which can crosslink with themselves. This has the result that, after the fibers have been coated with these fluorocarbons, the fibers are enclosed by a network formed by the resin groups (see Figure 3). The fluorocarbon groups project out from this network and exert their repelling effect with respect to, for example, water or dirt. These types of fluorocarbons are used, for example, for automobile canopy top material and have been found to give good results. The disadvantage is that the repelling effect described above is reduced or completely lost during the use of the canopy top material, in that the fluorocarbons are worn away by, for example, the wind caused by driving, by the friction created by dust, by repeated folding, and by other environmental effects as well. The network enclosing the fibers can be torn apart by the effects just

mentioned. Thus it is even possible for large areas of the repellent system to separate from the fiber product. This leads to an increase in the amount of dirt which can adhere to the fibers and thus gives the canopy top material an unattractive appearance. This problem is currently being dealt with by using only dark-colored canopy top materials. It is precisely in this area of application, however, that there is a desire to use colored fiber products which coordinate with the color of the motor vehicle.

US 6,063,474, furthermore, describes a thermoplastic fiber, especially a polyolefin fiber, the production of which includes the introduction of fluorocarbon esters into the polyolefin melt before it is extruded into fiber. If their nature allows, these incorporated fluorocarbon esters can become concentrated at the surface, where they can exert their repelling effect. Because neither the fluorocarbon group nor the hydrocarbon group belonging to the ester forms a bond with the thermoplastic fiber, the repellent is therefore held by purely mechanical means in the fiber mass in this case also. A permanent repelling effect can therefore not be expected.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a production process for a textile fiber with which a permanent repelling action is achieved.

This object is accomplished by a process for the production of a textile fiber preparing a spinnable polymer component and an ambivalent polymer compound which contains a repelling group and a residual group with an affinity for the spinnable polymer component, mixing the ambivalent polymer compound with the spinnable polymer component in a solvent, and spinning the mixture into a fiber, wherein the repelling groups orient themselves in the direction of the surface of the forming fiber and migrate to the surface, while the affine residual groups anchor the ambivalent polymer compound in the spinnable polymer compound as the solvent is driven off.

The essential feature of the textile fiber produced according to the invention is the ambivalent polymer compound, which is composed of two different groups, namely, the repelling group and a residual group, which has an affinity for the fiber matrix.

In contrast to the known substantive systems described above, which are present on the surface of the fiber, the repelling group in this case is bonded to the fiber polymer by way of the affine residual group. It is therefore virtually impossible for the repellent group to be rubbed off, because it would by necessary for the affine residual group to be torn out of the fiber polymer structure at the same time. Additional advantages and features can be derived from the subclaims.

Fluorocarbon groups are preferred as the repellent groups, but silicone polymers could also be used.

The affine residual groups are groups which have a definite affinity for the fiber polymer. If, for example, a polyacrylonitrile fiber is to be produced, ambivalent polymer compounds with nitrile groups as the affine residual groups are preferred. When other fiber polymers are used (polyamides, polyacrylates, etc.), the affine residual groups for the ambivalent polymer compound would be selected in correspondence with the chemical structure of the fiber polymer.

A composition consisting of a spinnable polymer component and an ambivalent polymer compound, where the affine residual group of the ambivalent polymer compound has an affinity for the

spinnable polymer component, can be used to produce textile fiber material such as monofilaments, multifilaments, fibers, yarns, or flat materials.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of the disclosure. For a better understanding of the invention, its operating advantages, specific objects attained by its use, reference should be had to the drawing and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

-- Figures 1a-1c show various stages of the production process for a textile fiber according to the invention;

-- Figure 2 shows a cross section of a textile fiber according to the invention; and

-- Figure 3 shows a cross section of a textile fiber according to the state of the art.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1a shows a composition according to the invention. The two essential components provided for the production of a textile fiber with a permanent repelling action, namely, the spinnable polymer component 1 and the ambivalent polymer compounds 2, are mixed together. The ambivalent polymer compound 2 has two different groups. The first is the fluorine-containing polymer chain as the repellent group 2.1, such as polytetrafluoroethylene. The ambivalent polymer compound 2 also has, at the other end, an affine residual group 2.2. This affine residual group 2.2 has the ability to interact with the fiber polymer 1. In Figure 1a, polyacrylonitrile is used as the fiber polymer 1, and a hydrocarbon with nitrile groups is used as the affine residual group 2.2. In the present example, the two polymer components 1 and 2 are dissolved in a solvent 3, especially a polyalcohol such as polyether glycol. The amount of the two polymer components 1 and 2 in the solvent is approximately 20-30 wt.%. After components 1 and 2 have been mixed together, the mixture is spun, during which the solvent is driven off. The repellent groups 2.1, which are repelled by the fiber polymer 1, start to orient themselves immediately in the direction of the arrows 4, that is, in the direction of the fiber surface (Figure 1b). The residual groups 2.2 slow down this

process as a result of their affinity for the fiber polymer 1. In Figure 1c, the spun fiber can be seen. The repelling groups 2.1 project out from the surface 5 of the fiber 6. Between the fiber polymer 1, i.e., the polyacrylonitrile, and the nitrile groups of the affine residual group 2.2 there are van der Waals interactions, as a result of which the ambivalent polymer compound 2 is held in the fiber structure. Depending on the amount of polymer compound 2 in the fiber 6, 10-15 wt.% being preferred, it is also possible, of course, for polymer compound 2 also to be present within the fiber, as indicated in Figure 2. These cannot arrive at the surface 5 until a space has become free at the surface 5.

Even if it is not completely clear from the figures, the fiber 6 has polymer groups 2.2 with repellent properties all the way around its circumference, that is, over its entire surface 5.

When we now compare this fiber according to the invention in Figure 2 with the state of the art, shown in Figure 3, the essential difference is obvious. Fluorocarbons 7.1 also project from the surface 5 of the known repelling fiber 1 and exert the repelling effect. At the terminal, however, there are no groups which are held in the fiber mass; instead, there is only a resin component 7.2, which reacts with itself and forms a network 8

enclosing the fiber 6. As a result of external influences, it is possible for the polymer compound 7 with its repelling group 7.1 to be torn out of the network, and it is even possible for whole areas of the network to be torn from the fiber. The fiber is then susceptible to attack by dirt in these areas.

In the case of the fiber 6 according to the invention (Figure 2), this is not possible or at least not possible to anywhere near the same extent, because the ambivalent polymer compound 2 is bonded to the fiber mass by way of the groups 2.2.

The compositions of polymer component and ambivalent polymer compound 2 used for the production of the textile fibers can contain other additives as appropriate for the area of application of the fibers. In the case of clothing textiles and material for the motor vehicle industry, furthermore, colored fibers are desired. In these cases, color pigments will be added to the compositions according to the invention. For other applications, admixtures of stabilizers, quenchers, slip agents, or ceramic or metallic reinforcing fibers are also conceivable.

While specific embodiments of the invention have been shown and described in detail to illustrate the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.